

A sense of social agency influencing uptake of numeracy in workplace education: A work-in-progress

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Abstract

This part of a continuing study of production workers' uptake of the Production Engineering Certificate in their workplace in Melbourne. I interviewed twenty-five employees in 1993. The preliminary results indicate their valuation of mathematics, mechanical knowledge, and communication skills, and concerns about change in their jobs. I suggest that workers' interest in numeracy, an important component of decision-making in any production operation, may depend, like communication skills, on their sense of social agency.

Introduction

Numeracy in the workplace

The numerical paraphernalia of statistical process control is evident on the noticeboards of most industrial workplaces, in the form of tables and graphs monitoring trends in production. Measurement is fundamental to decision-making in the production process, and now that production workers are being asked to take greater responsibility for measurements and decisions, one might expect a lively interest in numeracy skills, by trainer-educators and workers alike. Numeracy, here, is a term which reflects the part mathematics can play in process control. Implicit in recent definitions of numeracy (Yasukawa and Johnston, 1994), is a component of social agency.

Social agency as an orientation on knowledge

I needed a concept which took account, in an explicit way, of the politics of the workplace and approaches to learning. A sense of social agency, is a sense of one's right to act on one's own behalf, or as a group, and a recognition that others have a right to do the same. Social agency, is to a lesser or greater extent, a part of the learners' orientation on knowledge (see below), which I set out to learn about.

I have taken ideas from the theory of social differentiation, which was developed by Durkheim, Parsons, Luhmann, and others, to describe the social order in industrial society (Yeatman, 1990). It emphasizes the interdependence of groups within it. This interdependence is evident here in the continuing process of industrial negotiation, between the self-differentiated groups, management and unions. Later, I will show how this concept relates to education for social action, which I will link with decision-making and numeracy.

The workplace

At this light engineering plant in Melbourne, workplace re-structuring has heralded rapid changes, since the early 1990's. The work roles, practices and training procedures, built up slowly over the life of the forty year old presses, are being redefined. Once, skills were taught on the job, by experienced mechanics, to selected people. Now the emphasis has shifted from specific in-house job skills to generic skills, taught in the Engineering Production Certificate (EPC). These are intended to promote multi-skilling, and achieve transferability of skills to other

engineering workplaces. Access to the EPC is open to those wanting to participate, and it provides a forum in which new roles and workplace practices could be discussed.

The EPC in the context of workplace education

I have used Falk's four major categories of adult and workplace education which he describes as discourses, to locate the EPC philosophically (1993). These are:

- Adult and Community Education (ACE),
- Vocational Education and Training (VET),
- Human Resource Development (HRD),
- and Total Quality Management (TQM).

Each represents successive regions on a continuum of interests. At one end, the ACE discourse, is associated with the project of critical public education, education for personal development and social action. HRD and TQM, at the other end, are associated with what Falk calls, 'Fast Capitalism' in which education is linked specifically to production goals. VET, comes somewhere in the middle, with the industrial certificates, such as the EPC. This discourse does not have the strong tradition of social agency of the ACE, but it has the potential to incorporate this social agency. In doing so, this discourse could contribute to the implementation of creative workplace practices.

I have called the micro-discourses of education and training in this workplace, the old, the transition and the new. My focus here is on the training-in-transition discourse. This discourse reflects the (often unspoken) anxiety associated with the changing management styles, work practices and training procedures, all of which appear to impinge on the workers' uptake of the EPC.

Linking the concept of agency-in-learning with social agency

Mezirow values what he calls dialogic learning, which of necessity involves learners in debate. He specifies what he calls 'The Ideal Conditions For Learning' (1989, p. 171). In this, knowledge is socially constructed, and learning is a social activity in which learners test their perspectives/expectations against those of others, in a critical (micro-)discourse, in as safe a learning environment as possible, so that confidences are kept. The EPC forum and communication meetings (in *Communications* below) could provide such environments.

His theory of Transformative Learning is one that acknowledges orientations on knowledge (see under Research Questions) as significant in the way a learner approaches learning. Transformative Learning connotes a qualitative shift in thinking about subject material. In addition, he believes that learning is for social action (*praxis*),

The transformative learning process does not end in the classroom. Praxis is a requisite condition of transformative learning. It is not inherently a question of personal development versus social development or aborting social action by emphasizing individual development, although this too frequently happens. (1990, p. 156).

Education for social action is important in this study, firstly, because workers need to be agents in the re-negotiation of their roles and functions at work. Secondly, their willingness to learn mathematics may depend to a great extent on both learners' and trainers' beliefs about its usefulness, as a decision-making tool.

Research questions

My research interest is in learners' orientations on knowledge. These are the learners' perceptions of the origins and uses of knowledge, which are thought to affect their capacity to cope with complexity and uncertainty. Two major studies, by educational psychologists, suggested that students' orientations on knowledge progress through stages (Perry, 1968, and Belenky, Clinchy, Golberger and Tarule, 1986). According to Belenky et al., the progression depended on the development of "Voice", a sense of personal agency, in managing public and personally intuited knowledge, and in acting creatively. This sense of personal agency in the management of knowledges is important in this context, where workers knowledge of their production operation is often not articulated or recognized. For example, they may estimate measurements, without understanding the measurement systems that they are using (see Carole's comment on 'Functional Mathematics' below).

Copes, (1983), Buerk (1985) and Buckingham (1992) used Perry's and/or Belenky et al.'s schemes of development as interpretive frameworks to investigate students' concepts of mathematical knowledge in educational institutions. They found that there was a greater relational understanding of mathematics associated with learners who were able to see knowledges from several points of view, and a make judgements about what was most appropriate for the context. These industrial workers have had considerable experience of "concrete operations" in engineering production, unlike most younger learners, and this may be significant in their ways of relating to the formal learning of mathematics. The transition discourse, brought about by the industrial re-structuring, has provided me with the opportunity to hear workers' reflections on the relationship between their longstanding workplace knowledge, and

the EPC's generic skills, including mathematics. However, in practice, because of a lack of recognition of the mathematics used in their work, and language difficulties, it was appropriate to ask broader based questions, than I might have done in a school setting. in the hope that they might prompt discussion that would reveal orientations on this knowledge.

Conduct of the inquiry

The participants

The twenty-two participants were selected by invitation of workplace trainer-educators, as being people who would not mind being interviewed, and whose English language skills were adequate to understand the questions (participants between them spoke thirteen different languages at home), after a notice board request for volunteers drew no response. Five trainer-educators volunteered to be interviewed.

Interviews

I asked the shopfloor workers about their interests, priorities and learning experiences, in a semi-structured interview, which produced the comments and quantitative data below (Buckingham, 1994). About 20% of this group, were not taking part in the EPC.

I discussed the place of the EPC with five trainer-educators. I have used the views of two of these, here, to elaborate on the workplace education discourse that surrounds all these participants. Both men had a trade background. One, Michael, had worked for many years in the company, while the other, Ben, had gained qualifications in curriculum development, and been with the company since the start of the re-structuring program.

I have selected excerpts from interview data, which draw attention to matters concerned with agency, renegotiation of roles and practices, and uptake of the EPC. The first section, *Interest in mathematics, mechanical*

knowledge and speaking English, Communications, gives the opinions of shopfloor workers. The next, Training procedures, Business plans, Absenteeism, The new work process, and Participation in the Certificate, are a mixture of Michael's, Ben's and the workers' opinions.

Preliminary findings and comments

Interest in mathematics, mechanical knowledge and speaking English

Results for items considered in this paper, are listed in the table, nos. 1-4

Item of importance to interviewee	% expressing this (N = 16)
1 Speaking English	63
2 Communication skills	50
3 Workplace education	50
4 Calculating and measurement	30
5 Wanting to learn more maths	75

Responses in no. 5, came during a discussion of the measurement and calculation they used at work. Both men and women said that they would like to know more about machinery. Of the eight the operators, about half expressed interest in becoming a mechanic or multi-skilled. In some cases, they related these interests directly to gaining work skills, and upgrading their job classifications. This was very positive, in terms of having personal agency. Most of those interviewed were concerned about keeping their jobs.

Ferdinand: It would be helpful [to learn more about maths], to get more technical knowledge and education about machines, and technical things, to become a maintenance mechanic

George: To become a mechanic, maths would help.

Tony: Because it would mean a more easy job, and I would like it.

Faisal: I would like more maths.

These comments were made in relation to learning more mathematics, with no

These eighteen items listed below, were underlined and discussed by interviewees if they considered the item important:

home, work, family, workplace education, travel, speaking English, relaxation, solving problems, hobbies, repairs, social life, calculating, measuring, communication skills, school, education, household chores, shopping.

great sense of personal agency, communicated:

Netta: [I like] work. You learn new skills in machinery and ...[it's] fascinating.. It makes me want to learn more about my workplace and that. ... I just feel curious to improve my skills. ... Because I wasn't good at school at these [calculating and measuring]. I use a calculator

Anatoli: I like calculating. At school I was good at maths. The quickest in the class, also good at chemistry and history.

Ayalla: A little. I do it in my mind, myself, you know, not with a calculator. I'm good enough for that. Small things.

In a follow up interview, Carole commented on the module, 'Functional Mathematics, AATM01':

Carole: Good, yes. We didn't really want to do it. It's making me think again. It was area and volume, and

metrics.

Nice to know, not useful.
We didn't have a clue.
We had to go out and measure things.

Work out percentage reductions on meat; budgets; horse-racing, etc..
They try to make it relevant to very day life, not just work itself.

She was the one person who seemed to articulate a need for mathematics instruction which applied to her work. She valued the 'metrics', and felt this made measurement clearer. Trainer-educators, on the other hand, were not sure that further numeracy skills would be an advantage to the company as it ran now.

E.B.: If people were more competent in some area of numeracy or literacy, would that be an advantage?

Mick: I suppose it would be an advantage.

E.B.: Might things be arranged differently if they had more [numeracy skills]?

Mick: I doubt it, I doubt it. The way the place is structured at the moment I don't think it would. As far as the company is concerned, I think it runs fairly well with the ability they've got at the moment.

It is interesting to note that the item, *workplace education*, was received less enthusiastically (50% underlined it). This may be due to the uncertain outcomes of industrial negotiations surrounding the new work roles and practices, and the value placed on the EPC by management. (At that time it was DEET funded for a limited period.) The EPC has also been the subject of bans in the process of negotiation. Nevertheless, two workers with a good grasp of English, one of whom attended the EPC, and one of whom, did not, spoke strongly about the

need for change in the workplace. One referred to attitude, just as the trainers had done, but this time in connection with management taking a lead. Carole expressed the need for work issues to be approached collaboratively, by management and shopfloor workers:

Carole: The classes are the right size, but not enough are doing it. You learn it - but there's no manager or boss in to hear, nobody. We can't change things by ourselves. A whole section should come.

Communications

Workers' expressed need for the opportunity to improve their English speaking skills is underlined by the trainers comments:

Mick: I think the ones who had trouble with English, sort of hold back. If you don't go (to the EPC classes), you can't be embarrassed. I think there is a lot of that in it. Not that they can't do the work but 'if I don't stand up the front there then no one will see me', so they won't bother doing it.

E.B.: Yes, several people at the interviews have talked about business of Yspeaking in a group. Is there a trade union meeting?

Mick: No, not really. There is a communication meeting, just ... with the supervisor and 20 or 30 people and there is supposed to be open discussion. ...

E.B.: And they want to be able to speak up and they are troubled by not being able to speak up.

Mick: Well, they are troubled by the fact that the supervisor is not going to take any criticism, plus they stumble over the English a little bit, it makes a bit hard, they don't know

what their supervisor is thinking about, so they don't want to get too outrageous about what they say, because they're don't want to get into trouble, so they feel slightly intimidated I think.

Non-English speakers and women, lacked group agency, in the old order, and who were making efforts to be heard in this transition discourse, said that they faced embarrassment in the classroom, initially. Only five women were attending the EPC, of the initial fifty-five volunteers.

Training procedures

Ben:[Training on the] shop floor. ... It has always been a Learn-by-Nellie [system] and what tended to happen, was, that you were taught to do things this way, whether it was wrong or right, they did it that way.

This is apparently 'blind' adherence to training instructions, is indicative of the *expected* levels of agency by workers in the old order. Ben has a liaison role between trainers and management, and has information and scope for negotiation, that others do not, as the two excerpts below illustrate:

Business plans

Ben:There was a business plan for this level but it hadn't filtered down, it wasn't discussed ... I started to ask questions like: 'Where's our five year plan?'; 'What's our short term goals and what are our long term goals?'; ... So I said ... 'we really need to review what we're doing here, it's good fun writing all these programs, but where does it fit in, what works in with it, what options have these people got if they don't do this, how can we fit this in with the National system ...

Absenteeism

This was the individual and group response to a lack of agency in their own futures.

Ben:It was very noticeable that on the change of the shifts, that absenteeism was increasing, and when speculation starts to hit, like 'Hey! they're closing [this plant], hey! we're all going to get the sack.', ... You notice things like your machine efficiency goes down, your spoilage goes up, your absenteeism goes up.

Participation in the Certificate

Mick recalled some the reasons given for attending the EPC:

Mick:Well less, we've had classes of 8, we've had classes of 1 on their days off a couple of times. And the TAFE teachers have asked them:

'What are you doing this for?'

'I suppose, if you [don't, you] get the sack here'

'You've got to be prepared to pick up a job somewhere else'

Related to money. 'You are paid extra money for it, coming in, or time off'

I don't know..... Some of them definitely want to improve themselves.

You can tell. The ones that come along regularly they can see something in it for themselves. The ones that run hot and cold, I'm not sure [what] they're about. ... It's been explained that to educate yourself is a big advantage. Oh, it's all been explained to them. ... They're told it is to their benefit to take it all in, and you can use it for the rest of your life.

The new work processes

Ben reflected, tentatively on the new generic skills learning:

Ben: I think it's a beginning, I hope ... to see, ... firstly, ... they pick some of the skills they've got up, and use [them], and I think that's starting to come through now. And I think it should be the beginning of a new process where it's on-going.

Conclusion

I began this study looking for shifts in orientation in workers' learning of mathematics, prompted by the introduction of a generic skills workplace education course, the EPC. I have used the concepts of social agency, underpinned by Mezirow's theories, and the concept of numeracy, to underline that the mathematics is for workplace decision-making. I used the theory of social differentiation, to extend Mezirow's description of education for social action, into this industrial setting, and related the concept of social agency to Belenky et al.'s concept of "Voice". I have connected my interpretation of these ideas with what I learnt from the interviews.

Early in the process of interviewing, it was apparent that the stress and effort of all participants in accommodating the changes in the workplace, had a bearing on what workers were saying about learning mathematics. Out of this, I have distinguished three learner orientations toward mathematics.

Firstly, there is the *personal agency orientation*, evident in the group view that learning mathematics is a means to becoming a mechanic. It reflects a sense of personal agency in achieving promotion. It is a view from the old discourse, in the sense that it is recognized as a legitimate form of ambition.

Secondly, there is *masked agency orientation*. This group viewed mathematics as an activity that they had enjoyed at school, and they said that it had provided them with a sense of

achievement. Their sense of social agency is not so apparent. It may be masked, and if it is, this may be due to perceived risks in appearing to be too competent. It may connote the need for some groups, such as women and some non-English speakers, to avoid exposure to criticism.

Thirdly, there is *group agency orientation*. This group can critically appraise the usefulness of mathematics in the workplace, and is likely to be agentic in helping others to see the value of the subject. It is also associated with personal agency, and an expression of views about social interdependence of parties in the workplace.

These three agentic orientations have implications for educator-trainers who are considering locating, using and building on the knowledge of the workers, already in the workforce, in order to facilitate creative solutions in the restructuring process. Mathematics educators, because of their distance from the workplace culture, cannot easily learn how mathematics has been used in these settings. An understanding of these agentic orientations, could lead to a more sensitive teaching of the types of mathematics, needed by such workers.

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